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INL team completes treatment of unique nuclear fuel from Hanford reactor

IDAHO FALLS — During cleanup of the Hanford Site in southern Washington, one of the many challenging tasks the U.S. Department of Energy's Office of Environmental Management had to consider was what to do with several hundred kilograms of sodium-bonded, irradiated reactor fuel. The challenge was met at Hanford's sister site, Idaho National Laboratory.

The fuel in question came from Hanford's decommissioned Fast Flux Test Facility (FFTF) reactor, a 400-megawatt sodium-cooled reactor, which was a valuable part of DOE's fast reactor development program during its operations from 1982-1992. Of the 300 kilograms of FFTF fuel, 250 kilograms was irradiated and therefore highly radioactive, like all spent fuels. But, unlike the spent fuel coming from most reactors in the U.S., FFTF fuel was bonded with sodium. This made it much easier to keep cool, but also made it more difficult to handle, since sodium metal can react violently if exposed to air or water.

Dealing with this type of fuel, however, was within the capability of the INL team at DOE's lead nuclear energy research lab. Among the many specialized nuclear fuel research and handling capabilities at INL's Materials and Fuels Complex (MFC), the FFTF project required the capability to safely handle and treat fuels in an inert atmosphere.

At MFC, Idaho experts using proven technology changed reactive sodium in the fuel into non-reactive salt, making it easier to store.

"This project's success represents the successful integration of INL's Nuclear Science & Technology research staff and our highly skilled Nuclear Operations and support teams. Everyone involved provided close coordination, to demonstrate INL's capability to turn environmental liability into a successful treatment project," said John Grossenbacher, INL's lab director.

MFC's capability for dealing with sodium and fuel like FFTF's was born out of INL's work on a similar type of reactor, the Experimental Breeder Reactor-II (EBR-II). Like FFTF, EBR-II was a "fast reactor" that used liquid sodium for coolant. EBR-II operated from 1963-1994, and is currently in the process of decommissioning. Next to EBR-II's landmark silver dome, MFC's Fuel Conditioning Facility was built to safely handle and treat EBR-II's spent fuel in an argon atmosphere to eliminate the risk of sodium reactions.

While the FFTF fuel was safely stored in MFC's Hot Fuel Examination Facility, engineers first had to design and build a way to disassemble the fuel assemblies, and then in September 2010, operators began treating the irradiated FFTF fuel using MFC's unique electrometallurgical treatment technology. With this technology, metallic fuels can be easily processed to extract the enriched uranium-235, which is cast into low-enriched uranium ingots.

Of the 250 kilograms of irradiated FFTF fuel, MFC teams treated 219 kilograms, and are keeping the rest in storage for future use by INL's nuclear fuels research programs. Work is under way to handle the remaining 50 kilograms of unirradiated fuel. The treatment of the irradiated FFTF fuel was completed on time and within the $23.6 million budget, with the last of 24 batches of fuel elements treated on Sept. 26.

INL is one of the DOE's 10 multiprogram national laboratories. The laboratory performs work in each of the strategic goal areas of DOE: energy, national security, science and environment. INL is the nation's leading center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

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